REMARKS

The final Office Action of May 22, 2006, has been received and reviewed.

Claims 1-9 and 12-34 are currently pending and under consideration in the above-referenced application. Of these, claims 4, 9, and 23-34 have been withdrawn from consideration. Claims 1-3, 5-8, and 10-22, which have been considered, stand rejected.

Reconsideration of the above-referenced application is respectfully requested.

Rejections under 35 U.S.C. § 103(a)

Claims 1-3, 5-8, and 10-22 stand rejected under 35 U.S.C. § 103(a).

The standard for establishing and maintaining a rejection under 35 U.S.C. § 103(a) is set forth in M.P.E.P. § 706.02(j), which provides:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

<u>Crumly in View of Wada</u>

Claims 1-3, 5-8, 12, 13, 15-17, 19, and 20 have been rejected under 35 U.S.C. § 103(a) for being drawn to subject matter that is allegedly unpatentable over the subject matter taught in U.S. Patent 5,946,555 to Crumly et al. (hereinafter "Crumly"), in view of teachings from U.S. Patent 6,071,810 to Wada et al. (hereinafter "Wada").

Crumly teaches a process in which a preformed element, which Crumly refers to as a "substrate decal 16," such as a flexible polyimide film or a circuit board, is positioned over a semiconductor device 12. FIG. 1. The substrate decal 16 of Crumly includes apertures 27, which are aligned with corresponding bond pads 14 of the semiconductor device 12 as the substrate decal 16 is positioned over the semiconductor device 12. FIG. 1. Once the substrate

decal 16 has been positioned over and adhered to the semiconductor device 12 with adhesive 24 (FIG. 2), conductive material 32 is introduced into the apertures 27 of the substrate decal 16 and in contact with the bond pads 14 of the semiconductor device 12 (FIG. 3). Crumly indicates that sputtering or electrolytic deposition processes may be used to introduce conductive material into the apertures 27. Col. 2, lines 9-23.

The teachings of Wada relate to the introduction of conductive material into grooves and apertures in silicon dioxide films. Wada teaches, among other things, that an Al-Sn alloy may be deposited into the grooves and apertures by sputtering, and that the Al-Sn within the grooves and apertures may be heated to a liquid phase. It is readily apparent from the disclosure of Wada that the Al-Sn is not heated until after it is deposited, as the teachings of Wada in this regard are limited to heating the silicon dioxide film *after* sputtering (col. 102, lines 8-10) or heating the silicon dioxide film during sputtering so that the Al-Sn becomes liquefied once it is deposited on the silicon dioxide film (col. 102, lines 10-14).

It is respectfully submitted that there are several reasons that teachings from Crumly and Wada do not support a *prima facie* case of obviousness against any of claims 1-3, 5-8, 12, 13, 15-17, 19, of 20.

First, it is respectfully submitted that Crumly and Wada do not teach or suggest each and every element of any of claims 1-3, 5-8, 12, 13, 15-17, 19, or 20.

With respect to the subject matter to which independent claim 1 is drawn, it is respectfully submitted that neither Crumly nor Wada, taken either separately or together, teaches or suggests "introducing conductive material in an at least partially liquid state into at least one aperture." Rather, as noted at page 4 of the final Office Action, because the disclosure of Crumly is limited to use of sputter or electrolytic deposition processes to introduce conductive material into apertures, "Crumly does not appear to . . . disclose introducing the conductive material in an at least partially liquid state." The teachings of Wada are likewise limited to sputtering conductive materials to deposit the same within grooves or apertures of a silicon dioxide film. *See, e.g.,* col. 102, lines 8-14. Wada teaches that the conductive materials are not liquefied until after they have been deposited. *See, e.g., id.*

Second, it is respectfully submitted that, based on the teachings of Crumly and Wada, when considered in their entireties, one of ordinary skill in the art wouldn't have had any motivation to combine teachings from these references in the asserted manner. This is because the teachings of Crumly relate to the use of polyimide decals. As those of ordinary skill in the art are aware, polyimides are stable of temperatures of about 300° C. to about 400° C. *See* Lau, John H., CHIP ON BOARD TECHNOLOGIES FOR MULTICHIP MODULES, page 232 (Van Nostrand Reinhold, 1994), a copy of which is enclosed for the sake of convenience. Wada teaches, however, that a substrate upon which an Al-Sn alloy is deposited is "heated to a temperature of 420° C. or more . . . to obtain a liquid phase of the Al-Sn alloy." Col. 91, lines 37-40. While silicon dioxide films can withstand such temperatures, it is respectfully submitted that, without the benefit of hindsight that the claims of the above-referenced application provide, one of ordinary skill in the art wouldn't have been motivated to heat a polyimide film to such a high temperature.

Third, as one of ordinary skill in the art wouldn't have any reason to expect that the polyimide decal of Crumly could withstand the high temperature of the process disclosed in Wada, it is respectfully submitted that one of ordinary skill in the art would have had no reason to expect that teachings from Crumly and Wada could be successfully combined in the asserted manner.

Therefore, a *prima facie* case of obviousness has not been established against the subject matter recited in independent claim 1. As such, it is respectfully submitted that, under 35 U.S.C. § 103(a), the subject matter to which independent claim 1 is drawn is allowable over teachings from Crumly and Wada, taken either together or separately.

Each of claims 2, 3, 5-8, 12, 13, 15-17, 19, and 20 is allowable, among other reasons, for depending directly or indirectly from independent claim 1, which is allowable.

<u>Fjelstad, Crumly, and Wada</u>

Claims 1-3, 5-8, and 12-22 are rejected under 35 U.S.C. § 103(a) for reciting subject matter that is purportedly obvious in view of teachings from U.S. Patent 6,284,563 to Fjelstad (hereinafter "Fjelstad"), in view of the subject matter taught in Crumly and Wada.

The disclosure of Fjelstad relates to, among a variety of other things, placing polymeric sheets on and adhering them to semiconductor devices 100 to form passivation layers 130 over the semiconductor devices 100. Col. 8, lines 39-41. Once a passivation layer 130 has been applied to a semiconductor device 100, a registering system is used to locate contacts 110 of the semiconductor device. Col. 8, lines 41-43. Thereafter, removal processes are used to "selectively remove the passivation layer **130** above the contacts **110**." Col. 8, lines 46-49. Conductive material 150 is then plated onto the exposed contacts 110. Col. 9, lines 24-62.

Like Crumly and Wada, Fjelstad includes no teaching or suggestion of "introducing conductive material in an at least partially liquid state into . . . at least one aperture," as required of the method of independent claim 1. Furthermore, Fjelstad does not overcome the aforementioned deficiencies in the asserted combination of teachings from Crumly and Wada. Therefore, teachings from Fjelstad, Crumly, and Wada do not support a *prima facie* case of obviousness against any of claims 1-3, 5-7, or 12-22, as would be required to maintain the 35 U.S.C. § 103(a) rejections of these claims.

Crumly, Wada, and Fjelstad

Claims 14, 18, 21, and 22 also stand rejected under 35 U.S.C. § 103(a) for being directed to subject matter which is assertedly unpatentable over the teachings of Crumly, Wada, and Fjelstad.

Each of claims 14, 18, 21, and 22 is allowable, among other reasons, for depending indirectly from independent claim 1, which is allowable.

These claims are further allowable since one of ordinary skill in the art wouldn't have been motivated to combine teachings from these references in the asserted manner or any reason to expect that the references teachings could be successfully combined in such a way as to arrive at the inventions to which claims 14, 18, 21, and 22 are directed.

Crumly, Wada, and Jacobs or Crumly, Wada, Fjelstad, and Jacobs

Claims 21 and 22 have been rejected under 35 U.S.C. § 103(a) for reciting subject matter which is assertedly unpatentable over the teachings of Crumly and Wada, in view of teachings

from U.S. Patent 6,294,407 to Jacobs (hereinafter "Jacobs") or over the teachings of Crumly, Wada, Fjelstad, and Jacobs.

Claims 21 and 22 are both allowable, among other reasons, for depending indirectly from independent claim 1, which is allowable.

Withdrawal of the 35 U.S.C. § 103(a) rejections of claims 1-3, 5-8, and 10-22 is respectfully solicited, as is the allowance of each of these claims.

Election of Species Requirement

It is respectfully submitted that independent claim 1 remains generic to all of the species of invention of the second group that was identified in the Election of Species Requirement in the above-referenced application. In view of the allowability of these claims, claims 4, 9, and 23-34, which have been withdrawn from consideration, should also be considered and allowed. M.P.E.P. § 806.04(d).

CONCLUSION

It is respectfully submitted that each of claims 1-9 and 12-34 is allowable. An early notice of the allowability of each of these claims is respectfully solicited, as is an indication that the above-referenced application has been passed for issuance. If any issues preventing allowance of the above-referenced application remain which might be resolved by way of a telephone conference, the Office is kindly invited to contact the undersigned attorney.

Respectfully submitted,

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Date: August 22, 2006
BGP/sfc:eg
Document in ProLaw

CHIP ON BOARD TECHNOLOGIES FOR MULTICHIP MODULES

Edited by John H. Lau

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An International Thomson Publishing Company

New York • London • Bonn • Boston • Detroit • Madrid • Melbourne • Mexico City
Paris • Singapore • Tokyo • Albany NY • Belmont CA • Cincinnati OH

Library of Congress Catalog Card Number 93-40440
ISBN 0-442-01441-4

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Printed in the United States of America

Van Nostrand Reinhold
115 Fifth Avenue
New York, NY 10003

International Thomson Publishing
Berkshire House
168-173 High Holborn
London WC1V 7AA, England

Thomas Nelson Australia
102 Dodds Street
South Melbourne, Victoria 3205
Australia

Nelson Canada
1120 Birchmount Road
Scarborough, Ontario
M1K 5G4, Canada

International Thomson Publishing GmbH
Königswinterer Strasse 418
53227 Bonn
Germany

International Thomson Publishing Asia
221 Henderson Road
#05 10 Henderson Building
Singapore 0315

International Thomson Publishing Japan
Hirakawacho Kyowa Building, 3F
2-2-1 Hirakawa-cho, Chiyoda-ku
Tokyo 102
Japan

ARCFF 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2

Library of Congress Cataloging-in-Publication Data

Chip on board technologies for multichip modules / edited by John H. Lau.
p. cm.
Includes bibliographical references and index.
ISBN 0-442-01441-4
1. Electronic packaging. 2. Surface mount technology. I. Lau, John H.
TK7870.15.C55 1994
621.381'046—dc20 93-40440
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reactions – sometimes in the gas phase, but preferably on the surface – produce deposits on the wafer. The result is a high quality film deposited at a relatively low temperature.[10] As a passivator, PECVD silicon nitride is in compression.[15] Excessive thickness of the nitride has been known to cause high tensile stress in aluminum thin film lines and subsequent creep-induced voiding and failure.[18] Therefore nitride is kept thin, or modulated with an underlayer of SiO_2.

5.3.2 Polymers

Among polymeric materials, polyimides are the popular choice for chip passivation. They are stable at temperatures of 300 to 400°C, making them compatible with chip joining even with high lead solders. Film thickness and properties are readily controllable by the formulation and process parameters. A major advantage over inorganic passivations is the ability of polyimide to absorb thin film stresses imparted from the deposition of interconnection metallization and solder,[13] and from subsequent thermal exposures. This arises from its low elastic modulus and rapid stress relaxation, even at low temperatures.[19] Also, polyimides generally have a lower dielectric constant even than sputtered SiO_2. On the negative side, polyimides are more permeable to water and ionic contaminants, and may require adhesion promoters to insure adequate adhesion to the underlying organic or inorganic insulator.

Polyimide coatings are formed by spin coating a mixture of diamine and dianhydride monomers in a solvent, usually N-methyl-pyrrolidine 2 (NMP). For a fixed formulation, the thickness is directly related to the speed of rotation. The monomers combine at low temperatures to form polyamic acid, which, like its constituents, is soluble in NMP. The film is dried at about 100°C to remove most of the solvent, thence to 250-400°C to complete solvent removal and the conversion to polyimide. The commonly used pyromellitic dianhydride-oxydianiline (PMDA-ODA) family of polyimides are isotropic in behavior. New candidates, however, such as the long polymer chain biphenyldiaminine-phenyldiamine (BPDA-PDA) polyimides tend to be anisotropic in mechanical and electrical properties.[10]

5.4 TERMINAL METALS AND SOLDERS–MATERIALS

Following chip passivation, holes are etched with a photoresist mask, thus preparing the chip for terminal metals and solder. This section discusses the various material options available for the interconnection. Section 5.5 then describes the deposition processes currently in use.